SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

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Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF MECHANICAL ENGINEERING

19MEZ405- CASTING DESIGN AND PERFORMANCE

IV YEAR / VIII SEM

UNIT – 1

CASTING PROCESS

UNIT I CASTING PROCESS

Casting Process - Classification, characteristics of sand casting processes, metal mould casting processes and casting processes using other mould/core materials, Pattern materials, types of patterns, Mould and core making materials and their characteristics. The features of casting problem; a survey and scope of foundry industry

UNIT II CASTING DESIGN PRINCIPLES AND PRACTICES

Casting Design Issues and Practices - Casting Design and Processes -Modeling of Casting and Solidification Processing - Solidification of pure metals and al1oys; nucleation and growth in alloys; solidification of actual castings; progressive and directional solidification; centre in feeding resistance; rate of solidification, electrical analog of solidification problems

UNIT III PROCESS DESIGN

Process Design - Pattern design - Riser Design - Gating Design - Design for Economical Sand Molding - Design for Economical Coring – Moulding and Core Making Processing

UNIT IV CASTING DESIGN AND GEOMETRY

Design Problems Involving - Thin Sections - Design Problems Involving Uniform Sections - Design Problems Involving Unequal Sections - Design Problems Involving Junctions - Design Problems Involving Distortion

UNIT V CASTING PERFORMANCE

Corrosion of Cast Irons - Corrosion of Cast Carbon and Low-Alloy Steels - Corrosion of Cast Stainless Steels - Fatigue and Fracture Properties of Cast Irons - Fatigue and Fracture Properties of Cast Steels - Fatigue and Fracture Properties of Aluminum -Alloy Castings - Friction and Wear of Cast Irons - Friction and Wear of Aluminum-Silicon Alloys - Failure Analysis of Castings . Inspection of Castings

Mould and core making materials and their characteristics

Strength
The ability of the sand mold to hold its geometric shape under the conditions of mechanical stress.
Permeability
The ability of a sand mold to permit the escape of gases and steam during the casting process.
Moisture Content
Moisture content affects a mold’s strength and permeability: a mold with too little moisture may break apart, while a mold with too much moisture can cause steam bubbles to be entrapped in the casting.
Flowability
The capacity of the sand to fill small cavities in the pattern. High flowability creates a more precise mold, and is therefore useful for detailed castings.
Grain Size
The size of the individual particles of sand.
Grain Shape
This property evaluates the shape of the individual grains of sand based on how round they are. Generally, three grain categories are used in foundry sand:

Rounded Grain sands provide relatively poor bonding strength, but good flowability and surface finish.

Angular Grains have greater bonding strength because of interlocking, but poorer flowability and permeability than rounded grain sands.

Sub-angular Grains are the middle road. They possess better strength and lower permeability relative to rounded grains, but lower strength and better permeability than angular grains.

Collapsibility

The ability of the sand mixture to collapse under force. Greater mold collapsibility allows the metal casting to shrink freely as it solidifies, without the risk of hot tearing or cracking.

Refractory Strength

The mold must not melt, burn, or crack as molten metal is poured into it. Refractory strength measures the ability of molding sand to withstand extreme heat.

Reusability

The ability of molding sand to be reused (after sand conditioning) to produce other sand castings in subsequent manufacturing operations.

Metal mould casting involves using a reusable mould, often made from steel or cast iron, to shape molten metal. Common types include:

Permanent Mould Casting

Process: Uses a reusable metal mould with cavities designed for the desired shape. Molten metal is poured into the mould, allowed to solidify, and then removed.

Applications: Produces components like gears, wheels, and automotive parts.

Advantages:

High dimensional accuracy.

Smooth surface finish.

Suitable for high-volume production.

Die Casting

Process: Molten metal is injected into a metal mould (die) under high pressure using a hydraulic or pneumatic press.

Variants:

Hot Chamber Die Casting (suitable for low-melting-point alloys like zinc).

Cold Chamber Die Casting (used for aluminum and other high-melting-point alloys).

Applications: Produces precision components like engine blocks, housings, and fittings.

Advantages:

Excellent surface finish and detail.

High production rates.

Limitations:

Limited to small to medium-sized parts.

Not suitable for high-melting-point metals like steel.

Casting Processes Using Other Mould/Core Materials

These methods involve disposable or non-metallic moulds, offering flexibility in design and material compatibility.

Sand Casting

Process: A pattern is placed in sand to create a cavity. Molten metal is poured into the cavity, and the mould is broken to retrieve the casting.

Applications: Large, complex components like engine blocks and industrial machinery parts.

Advantages:

Low-cost moulds.

Can handle ferrous and non-ferrous metals.

Suitable for large-scale parts.

Limitations:

Rough surface finish.

Lower dimensional accuracy.

Shell Moulding

Process: A resin-coated sand mixture is used to create a thin shell mould around a heated pattern. After curing, the mould is removed and filled with molten metal.

Applications: Precision parts like valves and camshafts.

Advantages:

Excellent surface finish.

High dimensional accuracy.

Limitations:

Higher mould preparation cost than sand casting.

Investment Casting (Lost Wax Casting)
Process: A wax pattern is coated with ceramic to form a mould. The wax is melted away, and molten metal is poured into the ceramic mould.
Applications: Intricate parts like turbine blades and jewelry.
Advantages:
High precision.
Ability to cast complex geometries.
Limitations:
Expensive and time-consuming.

Plaster Mould Casting
Process: A plaster mixture is poured over a pattern to create a mould. Once hardened, molten metal is cast into the cavity.
Applications: Thin-walled parts with intricate details.
Advantages:
Excellent surface finish and detail reproduction.
Limitations:
Limited to non-ferrous metals.
Moulds are fragile.

Ceramic Mould Casting
Process: Similar to investment casting but uses a ceramic mould. The process can handle higher temperatures.
Applications: High-temperature alloys and aerospace components.
Advantages:
High precision.

Lost Foam Casting
Process: A foam pattern is placed in sand. When molten metal is poured, the foam vaporizes, leaving the cavity filled with metal.
Applications: Engine blocks, manifolds, and prototypes.
Advantages:
Simplifies mould-making for complex parts.
Cost-effective for intricate designs.

Aspect	Metal Mould Casting	Other Mould/Core Materials
Cost	High initial investment	Lower mould costs
Reusability	Reusable moulds	Mostly single-use moulds
Complexity	Limited intricate designs	Suitable for complex shapes
Surface Finish	Excellent	Varies based on process
Applications	High-volume production	Low to medium production volumes